

AIM OF THE WORK

The aim of the work is to evaluate the outcome of result of femoral shaft fracture treatment by DCP versus Nancy nails in 30 adolescents aged between eight and fourteen years.

PATIENTS

This work included thirty adolescents patients presented to Al Hadra University Hospital with femoral shaft fractures, treated with either DCP or Nancy nail.

Patients were divided into two groups by:

Group I: 15 patients were managed with DCP.

Group II: 15 patients were managed with Nancy nail.

Exclusion criteria:

1. Open fractures.
2. Pathological Fractures.

Demographic data

1. Age:

Patient's age ranged from 8 to 18 years. The mean age of patients in group I was 11.5 years (ranged from 8 to 14years) while the mean age in group II was 10.5 years (ranged from 8 to 14years). (Table 1, Figure 20)

2. Sex:

In group I, the male patients were twelve (80%) and the female patients were three (20%). While in group II, there were eleven males (73.3%) and four females (26.7%). (Table 1, Figure 20)

Table (1): Comparison between the two studied groups regarding age and sex.

	Group I		Group II		P
Age					
Range	8 - 14		8 - 14		
Mean	11.53		10.53		
S.D.	2.26		1.88		0.101
Sex					
Male	12	80.0	11	73.3	
Female	3	20.0	4	26.7	0.368

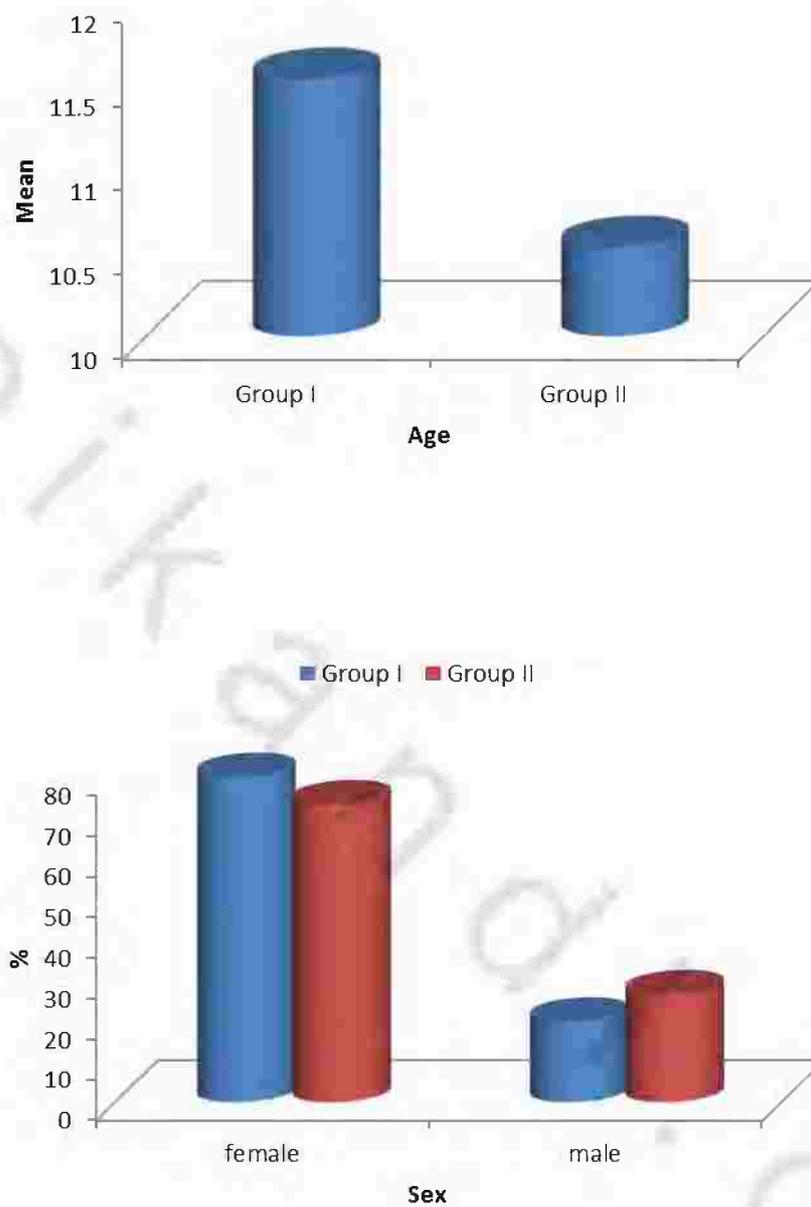


Figure (20): Comparison between the two studied groups regarding age and sex.

3. Affected side:

In group I, the affected side was right side in nine child (60%) and left side in 6 child (40%). While in group II the affected side was right side in 7 child (46.7%), left side in eight child (53.3%). (Table 2 ,Figure 21)

Table (2): Comparison between the two studied groups regarding the affected side.

Side affected	Group I		Group II	
	No.	%	No.	%
Right	9	60.0	7	46.7
Left	6	40.0	8	53.3
X²	1.89			
p	0.39			

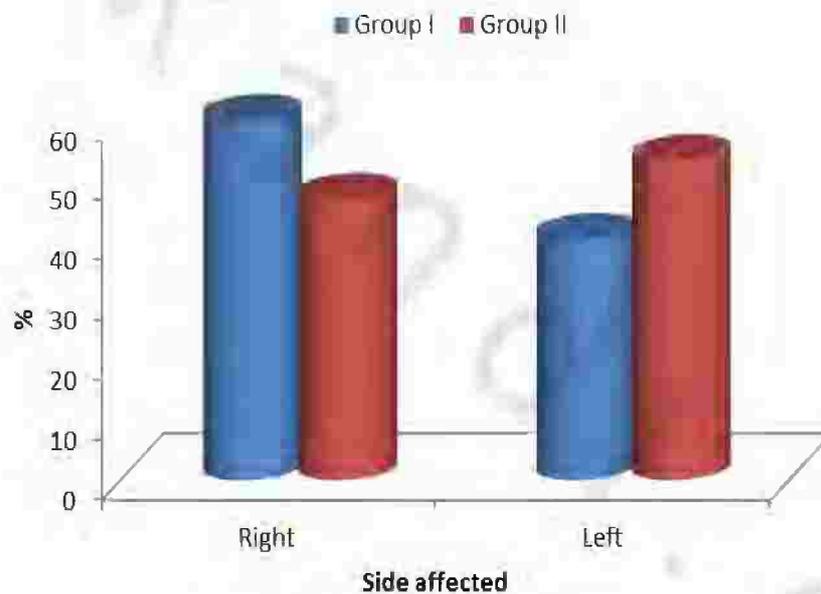


Figure (21): Comparison between the two studied groups regarding the affected side.

4. Mechanism of trauma.

In group I, ten (66.7%) patients were involved in road traffic accidents, and five (33.3%) patients were involved in falling from height (FFH). While in group II, eleven (73.3%) patients were involved in road traffic accidents (RTA), and four (26.7%) patients were involved in falling from height. (Table 3, Figure 22)

Table (3): Comparison between the two studied groups regarding the mechanism of trauma.

Mechanism of trauma	Group I		Group II	
	No.	%	No.	%
RTA	10	66.7	11	73.3
FFH	5	33.3	4	26.7
X ²	0.16			
P	0.69			

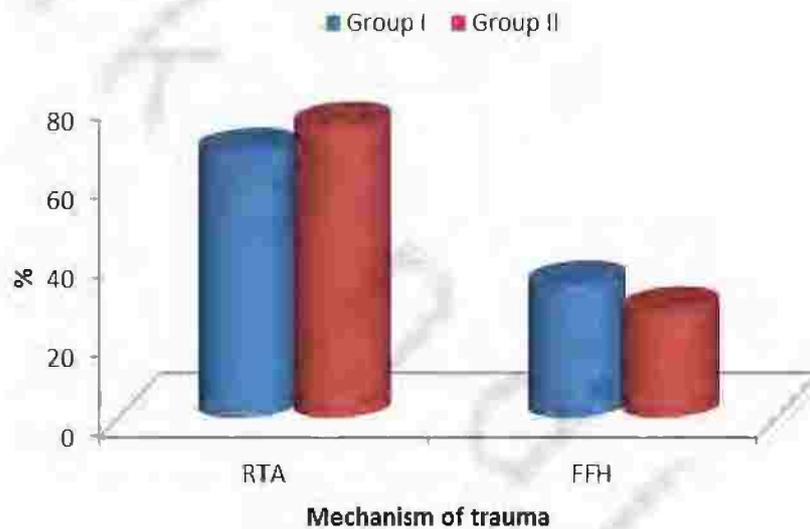


Figure (22): Comparison between the two studied groups regarding the mechanism of trauma.

5. Type of fracture:

The type of fracture in group I was non-comminuted in ten patients (60.7%), comminuted in five (33.3%), while in group II the fracture was non-comminuted in fifteen patients (100%), no comminuted fractures. (Table 4, Figure 23)

Table (4): Comparison between the two studied groups regarding type of fracture.

Type of fracture	Group I		Group II	
	No.	%	No.	%
Non-comminuted	10	66.7	15	100.0
Comminuted	5	33.3	0	0.0
X²	6.1			
p	0.014*			

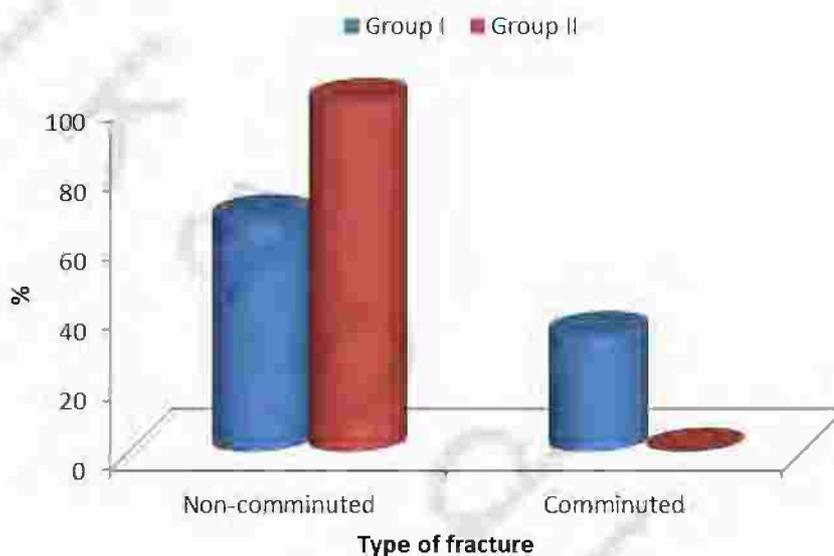


Figure (23): Comparison between the two studied groups regarding type of fracture.

6. Shape of fracture:

The shape of fracture in group I was transverse in 8 patients (53.3%), short oblique in 3 (20%), spiral in 4 (26.7%) and, while in group II the fracture was transverse in 10 patients (62.5%), short oblique in 1 (6.3%), spiral in 5 (31.3%). Table (5):

Table (5): Comparison between the two studied groups regarding shape of fracture.

Shape of fracture	Group I		Group II*	
	No.	%	No.	%
Transverse	8	53.3	10	62.5
Short oblique	3	20.0	1	6.3
Spiral	4	26.7	5	31.3
X ²	1.65			
p	0.325			

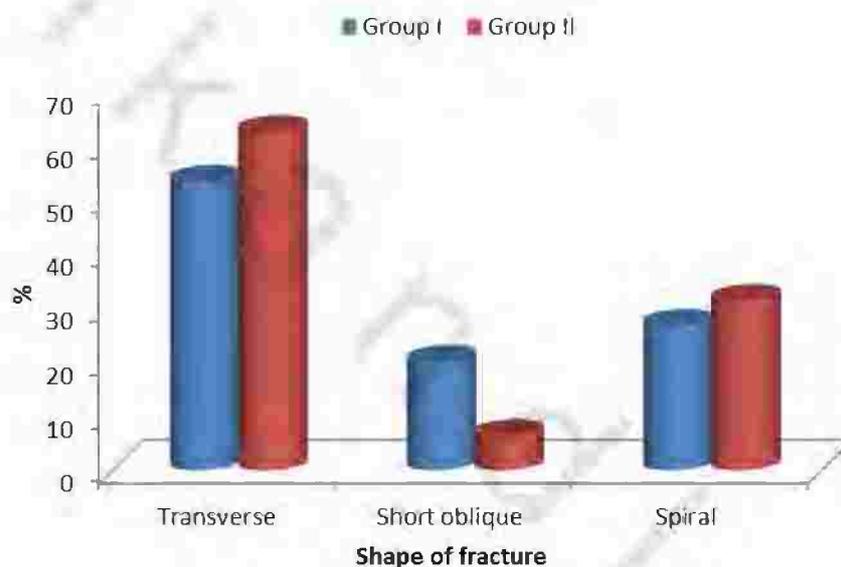


Figure (24): Comparison between the two studied groups regarding shape of fracture.

7. Presence of associated injuries:

In group I, four (26.7%) patients had associated injuries, while in group II one (6.7) patient only had associated injuries. (Table 6, Figure 25)

Table (6): Comparison between the two studied groups regarding presence of associated injuries.

Presence of associated injuries	Group I		Group II*	
	No.	%	No.	%
Yes	4	26.7	1	6.7
No	11	73.3	14	93.3
X^2	2.16			
p	0.16			

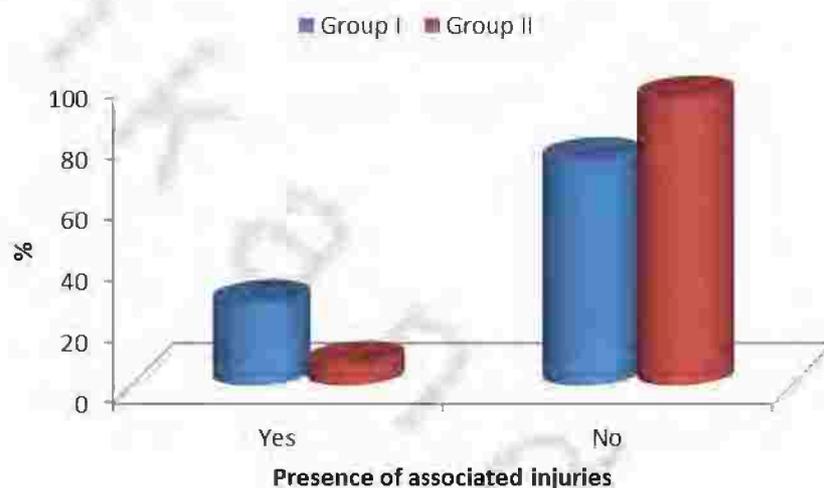


Figure (25): Comparison between the two studied groups regarding presence of associated injuries.

8. Time lapse before surgery and hospital stay:

In group I, Time lapse before surgery range from one to four days with average two days and hospital stay about 6.13 day , While in group II time lapse before surgery range from one to three days with average 2.1 day and hospital stay about 4.13 day. Table (7).

Table (7): Comparison between the two studied groups regarding time lapse before surgery .

	Group I	Group II	P
Time lapsed before surgery (days)			
Range	1-4	1-3	
Mean	2.00	2.13	
S.D.	0.93	0.74	0.417

Table (8): Comparison between the two studied groups regarding time hospital stay.

	Group I	Group II	P
Hospital stay (days)			
Range			
Mean			
S.D.	5-8 6.13 0.99	3-5 4.13 0.74	0.0001*

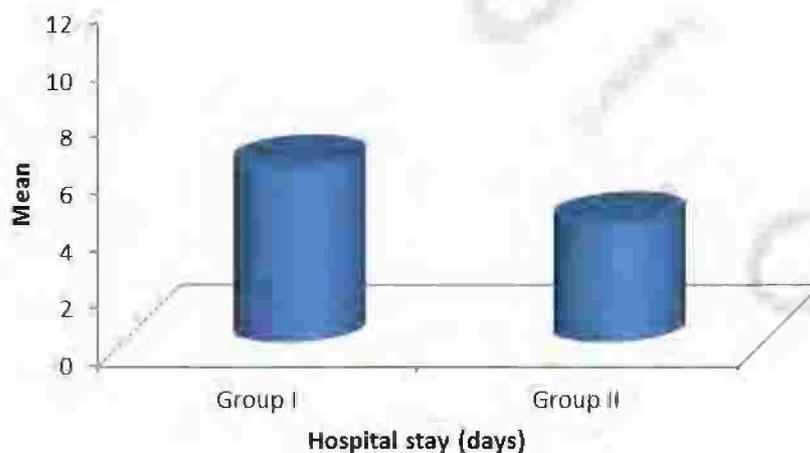


Figure (26): Comparison between the two studied groups regarding time lapse before surgery and hospital stay.

METHODS

Clinical assessment

On admission, patients were clinically assessed as follows:

Personal data

- Name
- Age
- Sex
- Address

Complaints

- Pain.
- Swelling of the thigh.
- Inability to use the injured limb.
- Affection of other regions

History of the present symptoms

- Time of injury
- Mechanism of injury
- Side affected

Clinical examination

- Noticing any swelling or deformity
- Palpation for tenderness
- Skin condition
- Examination of the whole body for other associated injuries
- Vascular and neurological examination of the affected limb.

First aid treatment

- The fractured limb was splinted by fixed skin traction on a Thomas splint.
- Analgesic and anti-oedematous measures were prescribed.
- Patients were put under observation in the hospital until time of surgery with management of any associated injuries and medical conditions.

Radiological evaluation

- Antero-posterior view of the pelvis
- Antero-posterior and lateral view radiographs of the affected femur (including the hip and knee joints) were taken to assess the level and shape of fracture.

Surgical Techniques:

1. Elastic Intramedullary Nailing Technique:

- Elastic intramedullary nails inserted under image intensifier control were used to treat fifteen patients, using two pre-bent titanium nails inserted in retrograde or antegrade fashion.
- Basic requirements of this technique included (Figure 27):
 - Titanium nails (400 mm in length, of different diameters; 2.0mm, 2.5mm, 3.0mm, 3.5mm, 4.0mm, 4.5mm)
 - Bone Awl
 - Cannulated T-Handle inserter
 - Nail cutter
 - Mallet



Figure (27): Implants and instruments.

- Steps of surgery:
- The operation was carried out under general anaesthesia and complete aseptic conditions. The patient was positioned on an orthopaedic traction table (Figure 28).
- An image intensifier was positioned so that it can be rotated to obtain anteroposterior and lateral views of the whole femur from the hip to the knee joint.
- The entire thigh including the knee was prepared as an operative field. Closed manipulation was conducted until adequate reduction was obtained and confirmed by fluoroscopy.



Figure (28): Patient positioning.

- The diameter of the individual nail was chosen by calculation (*nail diameter = minimum canal diameter x 0.4*).⁽³⁸⁾ The amount of bending = $3 \times$ canal diameter.
- To avoid varus or valgus angulation, both nails were always of identical diameter.
- Each nail was pre-bent at the same point by hand to an angle of 30° , ensuring that the tip lies in the same plane as the plane formed by bending, and that the apex of curvature lies at the level of the fracture site. In order to achieve optimum reduction, stabilisation and alignment of the fracture, the curvature had to be identical in both nails and the apex of bending at fracture site. (Figure 29).



Figure (29): Pre-bending the nail.

- A 2cm skin incision distal to the required bone entry hole was made. Starting either on the lateral or medial side. Regarding the entry point, the following precautions were taken into consideration:
 - The entry point should be 2 – 4 cm away from the growth plate
 - The lateral and medial entry points should be at the same level
 - The entry hole should be slightly larger than the diameter of the chosen nail
- The holes were performed by a bone awl and directed diagonally at an angle of 45° towards the far cortex to make the hole accommodating the direction of progressing nail. (Figure 30)



Figure (30): Entry hole.

- The nail was held in a camulated T- handle with the horizontal bar of the T-handle and the curved tip of the nail aligned in the same plane (this allowed identification of the curved tip as it passed along the medullary canal).
- The nail was passed through the entry hole with the curved tip pointing downwards. Once in the medullary canal it was rotated to point in the direction in which the nail is to be passed. (Figure 31)
- The nail was driven up the canal by rotating the T-handle back and forth. With a mallet, the nail was gently tapped to cross the fracture site. The nail was advanced towards the metaphysis to anchor into the cancellous bone.
- Nail should have maximum cortical contact at the fracture site in opposite direction.



Figure (31): The first pre-bent nail advanced to the fracture site.

- The second nail was advanced using the same rotating movements and light taps. However, it was never rotated on its own axis through a full 360° to avoid wrapping itself around the first nail.
- Both nails were advanced and impacted at their final proximal points.
- The nail entering the lateral cortex of the distal femur ends just distal to trochanteric apophysis, while the nail introduced through the medial distal femoral cortex ends at the same level but pointing towards the calcar region of the femoral neck (Figure 32).



Figure (32): Proximal positioning of the nail.

- Reduction of the fracture and nail position were confirmed with the image intensifier. If the fracture was distracted, traction was released and the patient's heel was impacted.

- The ends of both nails were cut, ensuring that 1 to 2 cm of each nail remains outside the entry hole lying against the supracondylar flare (Figure 33).



Figure (33): Nail Cutting

- Wound was irrigated and closed in layers.
- Sterile dressing and crepe bandage was applied.
- In order to prevent distraction of the fracture, a slight blow on the knee was usually applied.

Postoperative care

- Early immobilization was required in hip spica. The limb was simply rested on a pillow.
- Check X-rays were obtained to assess the reduction and the position of the nails.
- The patient was examined for vascular and neurological status.
- Cephalosporin is administered for 24 hours.
- Analgesics and anti-oedematous medications were prescribed.
- The patient was encouraged to extend the knee and reinforce the quadriceps muscle.
- Ambulation using support but without weight bearing was allowed as soon as the fracture was pain-free.

Follow up

- The stitches and the crepe bandage were removed after two weeks.
- After removal of the stitches gentle active exercises were started gradually if the wound has healed and the fracture was stable.
- Check X-rays (anteroposterior and lateral views) were obtained after two, six, and twelve weeks then monthly until the end of follow up period.
- Partial weight bearing with support was allowed when the fracture was pain-free and bridging callus was evident radiologically.
- According to fracture healing and as soon as the patient felt ready, full weight bearing was allowed.
- The mean follow up period was thirty-two weeks (range from twenty-four to seventy-two weeks).

Nail Retrieval

- The removal procedure was always performed under general anaesthesia, using a tourniquet, after radiographic confirmation of solid fracture healing (range from three to seven months).
- The medium-size "bone biter" was very helpful for initial nail grasp, allowing secure grip of the nail in the beginning of the retrieval. Once the nail was retracted a few millimetres, removal was usually completed by hand. If the nail was difficult to remove by hand, the cannulated T-handle and mallet were used to complete removal.

2: surface fixation by plating technique:

- **Basic requirements of this technique included:**
 1. **Broad and Narrow Dynamic Compression Plates.**



Figure (34): Dynamic Compression Plate

2. **Standard screws set.**
- **Steps of surgery:**
 - The operation was carried out under general anaesthesia and complete aseptic conditions.
 - The patient was positioned on an operative table on lateral decubitus.
 - Sterile draping after disinfection of the thigh.
 - Lateral approach to the femur.
 - Open reduction and internal fixation of fracture femur according to AO principles of fixation.
 - Closure of the wound in layers, after insertion of closed suction system (vacuum).

Postoperative:

- Patients are allowed to sit on the day of surgery.
- Drains are left in place for 48 hours.
- Cephalosporin is administered for 24 hours.
- Patients are encouraged to perform active range of motion exercise of the knee.
- Strengthening exercises are not encouraged because excessive force is applied to the plate-bone or screw-bone interface, and the direction of force is not well controlled.
- When fracture union is evident radiographically, partial weight bearing for 1 month is allowed, then aggressive strengthening exercises are begun.
- Unrestricted weight bearing is then permitted.

Assessment

- All patients were assessed after two weeks, six weeks, twelve weeks according to the following Neer's modified scoring system, shown in Table 9.⁽⁸⁸⁾

Table (9): Neer's modified score.⁽⁸⁸⁾

	Rating	Points
Pain	No pain	20
	Intermittent (in bad weather)	16
	With fatigue	12
	Pain restricting function	8
	Constant or at night	4-0
Function	As before injury	20
	Mild restriction	16
	Restricted stairs sideway	12
	Cane or severe restriction	8
	Crutches or braces	4-0
Motion of the knee	Normal or 135°	20
	120°	16
	100°	12
	80°	8
	60°	4-0
Angulation, rotation or deformity	Near normal	15
	Malrotation	12
	15° angulation or 2 cm displacement	6
	Union but with greater deformity	3
	Nonunion or chronic infection	0
Shortening	No shortening	15
	0.5 cm shortening	12
	2 cm shortening	9
	3 cm shortening	6
	More than 3 cm shortening	3
	Nonunion with a gap and shortening	0
Work or activities	As before injury	10
	Regular but with handicap	8
	Alter work	6
	Light work	4
	No work	0

Each item of assessment is classified into five grades. Each grade has its own scoring points.

Grades of Constant score:

- 1. Poor.** (Less than 34points)
- 2. Moderate.** (34- 57 points)
- 3. Good.** (57- 80 points)
- 4. Excellent.** (80- 100points)

For the purpose of statistical analysis, excellent and good results were considered satisfactory, while moderate and poor results were considered unsatisfactory.

STATISTICAL ANALYSIS

The data was collected and entered into the personal computer. Statistical analysis was done using Statistical Package for Social Sciences (SPSS/version 15) software.

The statistical tests used were:

1. Arithmetic mean (\bar{X}):

Was calculated as follows:

$$\bar{X} = \frac{\sum X}{n}$$

Where:

\bar{X} = arithmetic mean

$\sum X$ = sum of observations

n = number of observations

2. Standard deviation (SD):

Was calculated as follows:

$$SD = \sqrt{\frac{\sum X^2 - \frac{(\sum X)^2}{n}}{n - 1}}$$

Where:

$\sum X^2$ = sum of squared observations.

$(\sum X)^2$ = square of the sum of observations.

n = number of observations.

3. "t" test:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{S_p^2 \left(\frac{1}{n_1} + \frac{1}{n_2} \right)}}$$
$$S_p^2 = \frac{S_1^2(n_1 - 1) + S_2^2(n_2 - 1)}{n_1 + n_2 - 2}$$

Where:

S_p^2 = Pooled variance.

S_1^2 = Variance of sample (1).

S_2^2 = Variance of sample (2).

n_1 = Size of sample (1).

n_2 = Size of sample (2).

\bar{X}_1 = Mean of sample (1).

\bar{X}_2 = Mean of sample (2).

S_1 = Standard deviation of sample (1).

S_2 = Standard deviation of sample (2).

5. Chi-square (χ^2):

For comparison between distributions of patients according to different items of study using this formula for calculation:

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

O = Observed results

E = Expected results

$(O - E)^2$ = differences squared

Where $E = \frac{\text{Total row} \times \text{total column}}{\text{Grand total}}$

p is significant if < 0.05

6. Fisher's Exact test:

Was also used for comparison of categorical data, using this formula for calculation:

$$P = \frac{t1 \times t2 \times t3 \times t4}{X \times x1 \times x2 \times x3 \times x4}$$

t1 and **t2** are rows' totals,

t3 and **t4** are columns' totals

X is total number of subjects

x1, x2, x3 and **x4** are 4 frequencies

RESULTS

Results at the end of follow up period:

Table (10), Figure(35) shows the final score in the two studied groups, it was found that all patients in group II who were treated by Nancy nails had excellent results, while 73.3% of group I that used DCP was excellent results, one patients good, one patients faire and 2 patients was poor, on comparing the two studied groups regarding the final score it was found that there was a significant increase in the final score in group II than group I. ($p < 0.05$).

Table (10): Final score in the two studied groups.

Final score	Group I		Group II*	
	No.	%	No.	%
Satisfactory	12	80.0	15	100.0
Excellent	11	73.3	15	100.0
Good	1	6.7	0	0.0
Unsatisfactory	3	20.0	0	0.0
Fair	1	6.7	0	0.0
Poor	2	13.3	0	0.0
X²	4.62			
p	0.048*			

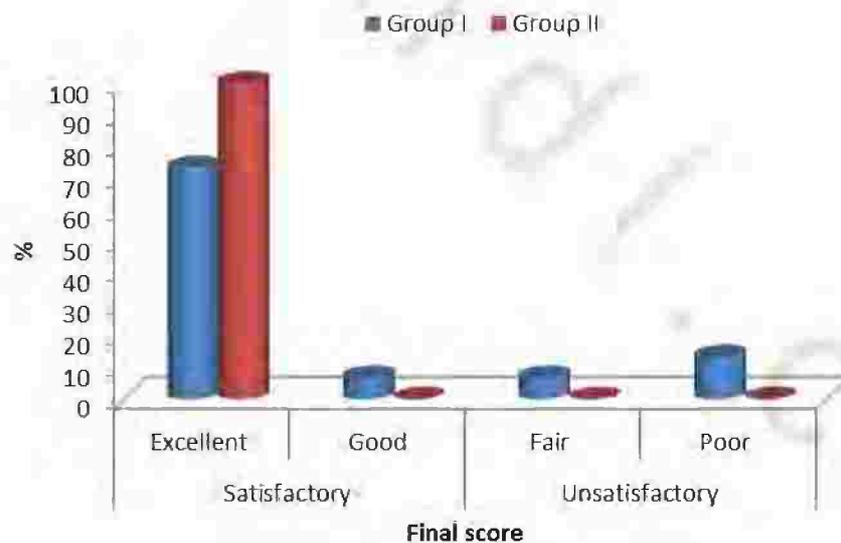


Figure: (35): Comparison between the two studied groups regarding final score

Relation between the union time and the method of fixation:

Table (11), Figure (36) shows comparison between the two studied groups regarding union time, it demonstrated that, union time ranged between 8-18 and 8-18 with the mean of 12.27 ± 2.74 and 10.73 ± 2.66 for group I and II respectively, there were no statistical significant differences between the two studied groups. ($P=0.074$)

Table (11): Comparison between the two studied groups regarding union time (weeks).

Union time	Group I	Group II
Range	8-18	8-18
Mean	12.27	10.73
S.D.	2.74	2.66
T	1.68	
p	0.074	

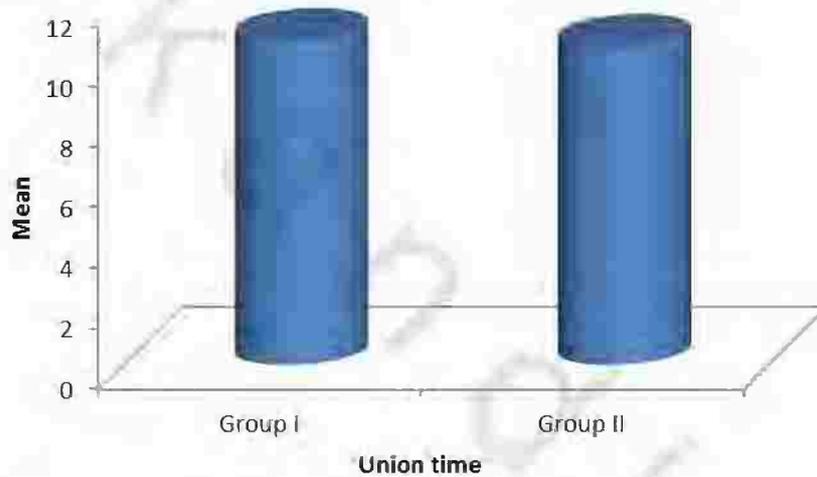


Figure (36): Comparison between the two studied groups regarding union time.

Relation between the final score and the sex:

Table (12), Figure (37) shows the relation between final score and the sex of the patients, it was found that there was no significant relation between the sex of the patients and the final score ($p > 0.05$).

Table (12): Sex in relation to final results

Sex		Final results		Total
		Satisfactory	Unsatisfactory	
female	No.	6	1	7
	%	22.2	33.3	23.3%
male	No.	21	2	23
	%	77.8	66.7	76.7%
Total	No.	27	3	30
	%	100.0%	100.0%	100.0%
X ²		1.733		
P		.630		

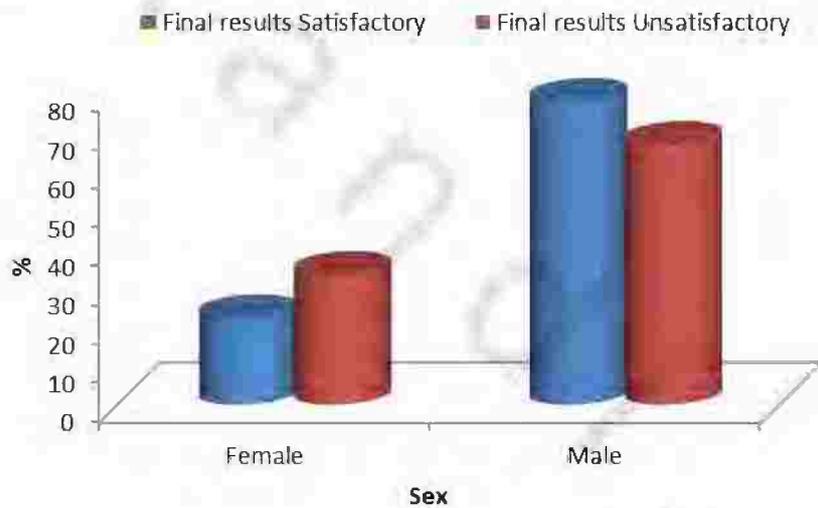


Figure (37): sex in relation to final results

Relation between the final score and the age:

Table (13), Figure (38) shows the relation between age and final score, from this table show no significant relation between the age of the patients and the net results ($p > 0.05$)

Table (13): Relation between final score and age of the patients.

Age(years)		Min.	Max.	Mean	S.D.	t	p
	Satisfactory	8.00	14.00	10.982	2.16	.322	.809
	Unsatisfactory	9.00	14.00	12.12	2.36		

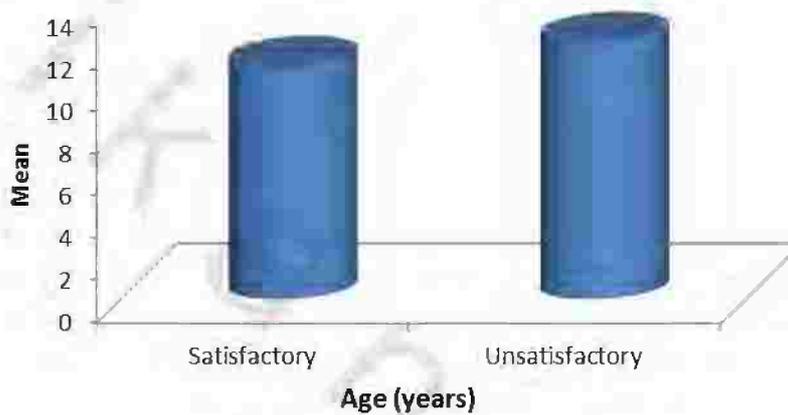


Figure (38): Relation between final score and age of the patients.

Relation between the final score and the affected side:

Table (14), Figure (39) shows the relation between the affected side and the net results, from this table it was found that there was no significant association between the side affected and the final score ($p > 0.05$).

Table (14): side affected in relation to final results

Side affected		Final results		Total
		Satisfactory	Unsatisfactory	
Right	No.	14	2	16
	%	51.9	66.7	
Left	No.	13	1	14
	%	48.1	33.3	
Total	No.	27	3	30
	%	100.0%	100.0%	100.0%
X ²		5.315		
P		.947		

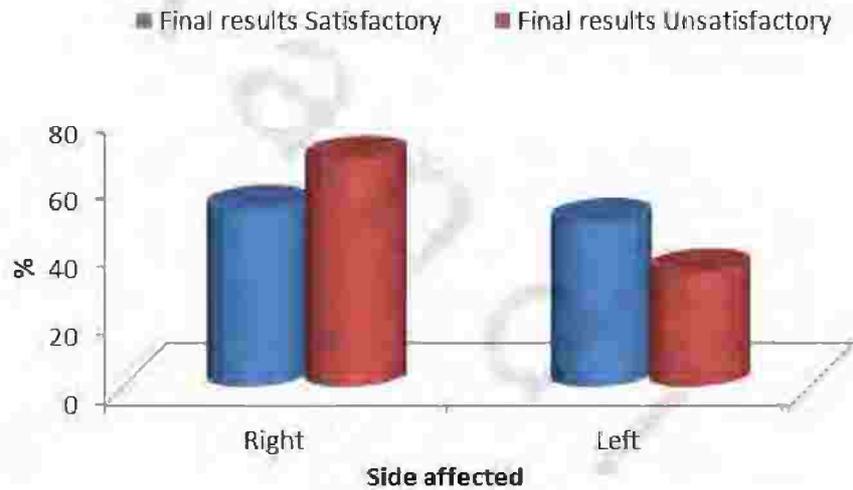


Figure (39): side affected in relation to final results

Relation between the final score and the mechanism of trauma:

Table (15), Figure (40) shows the relation between mechanism of trauma and the final score, the two mechanism of trauma show no significant effect on the net results, ($p > 0.05$).

Table (15): Mechanism of trauma in relation to final results

Mechanism of trauma		Final results		Total
		Satisfactory	Unsatisfactory	
FFH	No.	8	1	9
	%	29.6	33.3	
RTA	No.	19	2	21
	%	70.4	66.7	
Total	No.	27	3	30
	%	100.0%	100.0%	100.0%
X ²		5.62		
P		.315		

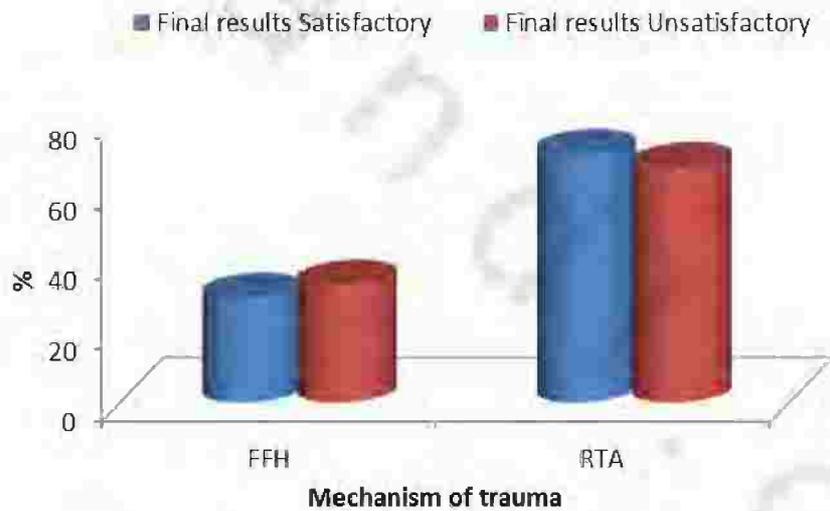


Figure (40): mechanism of trauma in relation to final results

Relation between the final score and the type of fracture:

Table (16), Figure (41) shows the relation between final score and the type of fracture, from this table it was found that there was no significant effect of the type of fracture on the final results ($p > 0.05$).

Table (16): Type of fracture in relation to final results

Type of fracture		Final results		Total
		Satisfactory	Unsatisfactory	
Comminuted	No.	5	0	5
	%	18.5	0.0	
Non Comminuted	No.	22	3	25
	%	81.5	100.0	
Total	No.	27	3	30
	%	100.0%	100.0%	100.0%
X^2		4.709		
P		.194		

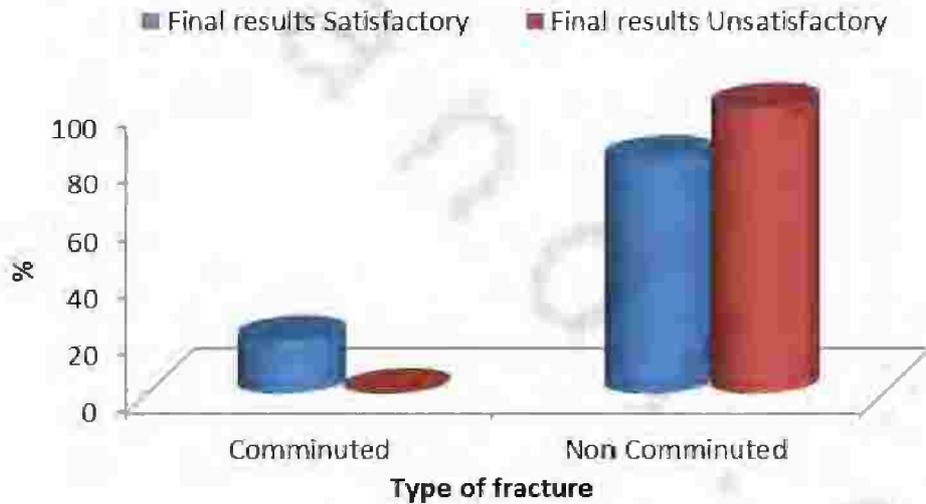


Figure (41): Type of fracture in relation to final results

Relation between the final score and the level of fracture:

Table (17), Figure (42) shows the relation between level of fracture and the final results, it was found that there was no significant relation between level of fracture and the final score ($p > 0.05$).

Table (17): level of fracture in relation to final results

Level of fracture		Final results		Total
		Satisfactory	Unsatisfactory	
lower third	No.	3	0	3
	%	11.1	0.0	10.0
Middle third	No.	18	3	21
	%	66.7	100.0	70.0
Upper third	No.	6	0	6
	%	22.2	0.0	20.0
Total	No.	27	3	30
	%	100.0%	100.0%	100.0%
X ²		7.22		
P		0.685		

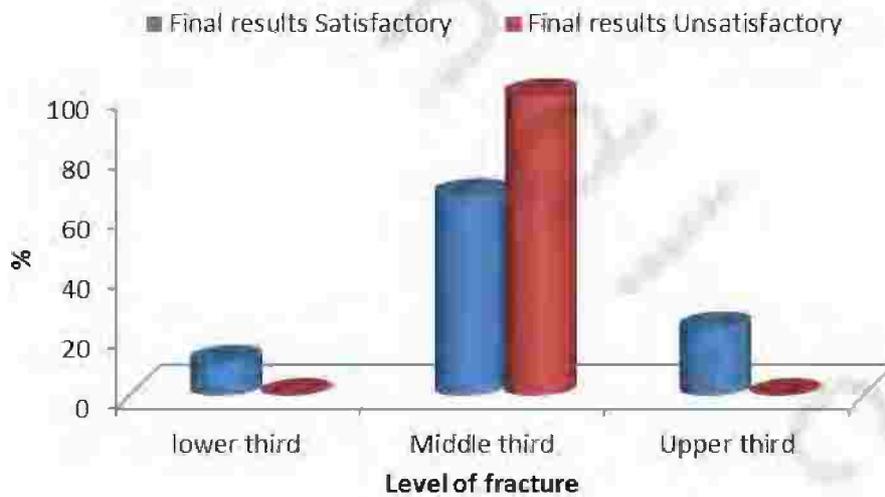


Figure (42): level of fracture in relation to final results

Relation between the final score and the shape of fracture:

Table (18) ,Figure (43) shows the relation between final results and the shape of fracture, it was found that there was no significant relation between shape of fracture and final results ($p > 0.05$).

Table (18): shape of fracture in relation to final results

Shape of fracture		Final results		Total
		Satisfactory	Unsatisfactory	
oblique	No.	4	0	4
	%	14.8	0.0	
spiral	No.	9	0	9
	%	33.3	0.0	
transverse	No.	15	3	18
	%	55.6	100.0	
Total	No.	27	3	30
	%	100.0%	100.0%	100.0%
X ²		6.98		
P		0.425		

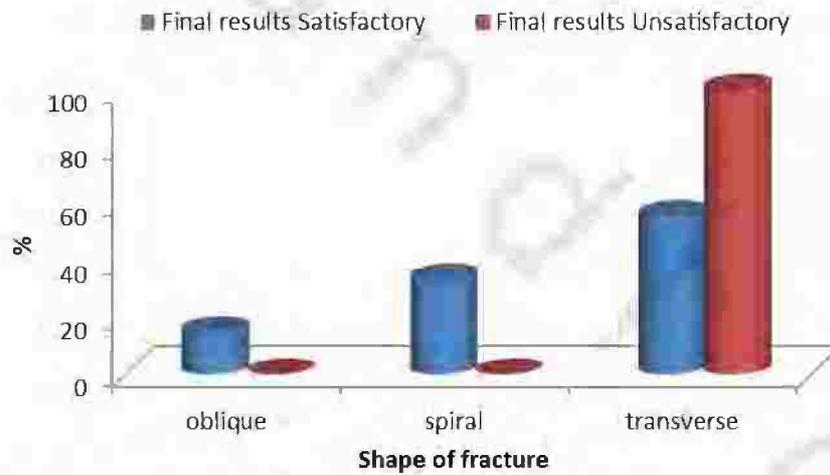


Figure (43): shape of fracture in relation to final results

Relation between the final score and the time lapse before surgery:

Table (19), Figure (44) shows the relation between time lapse before surgery and final score, from this table. It was noticed that the satisfactory results show a short time lapse before surgery, while in unsatisfactory the time lapse before surgery was longer, This was found to be statistically significant ($p < 0.05$)

Table (19): Relation between final score and time lapse before surgery.

Time lapse before surgery	Mean	S.D.	Min.	Max.	t-test	p
Satisfactory	1.982	.769	1.00	3.00	2.45	.041*
Unsatisfactory	3.92	0.711	2.00	4.00		

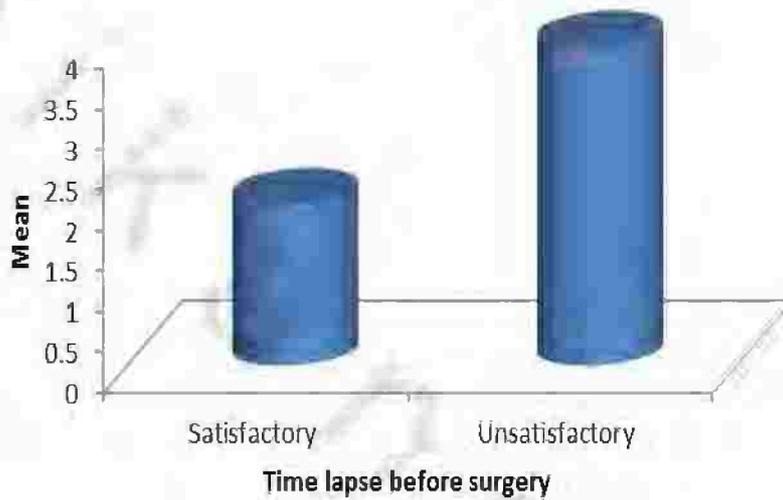


Figure (44): Relation between final score and time lapse before surgery.

Relation between the final score and the time of union:

Table (20), Figure (45) shows the relation between time of union (weeks) and the final score, it was found that the satisfactory patients had short time to union more than the unsatisfactory, in satisfactory was 11.84 ± 2.21 , while the mean duration in unsatisfactory was 15.0 ± 6.36 weeks. On comparing the duration of union in different score groups it was found that there was a significant increase in union time in unsatisfactory results than the satisfactory. ($P < 0.05$).

Table (20): Relation between final score and Union time (wks)

Union time (wks)	Min.	Max.	Mean	S.D.	F	Sig.
Satisfactory	8.00	18.00	11.84	2.21	3.002	.0407*
Unsatisfactory	9.00	18.00	15.0	6.36		

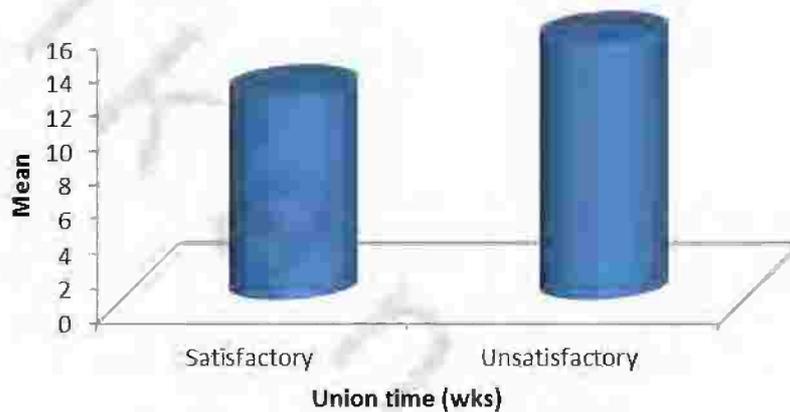


Figure (45): Relation between final score and Union time (wks)

Relation between the method of fixation and postoperative complications:

Table (21), show the comparison between the two studied groups regarding the incidence of postoperative complications, it demonstrated that, most of the postoperative complications were found in group I, with statistical significant differences.

Table (21): Comparison between the two studied groups regarding the incidence of postoperative complications.

postoperative complications	Group I		Group II*		p
	No.	%	No.	%	
Deep Infection	3	20.0	0	0.0	0.089
Delayed union	0	0.0	0	0.0	-
Non union	3	20.0	0	0.0	0.089
Valgus/ varus	2	7.4	0	0.0	-
Anteroposterior Mal union	2	7.4	0	0.0	-
Rotation	0	0.0	2	7.4	-
Nail protrusion	0	0.0	3	20	0.089
blood transfusion	3	20.0	0	0.0	0.089
Limb length inequality					
Lengthing	0	0.0	6	22.2	
Shortening	0	0.0	1	3.7	

COMPLICATIONS

1) **Pain at nail insertion site:**

In group II only, Pain or irritation at the insertion site of the nail occurred in three (20%) out of fifteen patients. This symptom was associated with nail ends that were prominent more than 10mm from the side of the femur. All of the three patients also had their nails removed as soon as radiographs confirmed solid fracture healing (about three months postoperative). After nail retrieval, the symptoms improved (Figure 46).



Figure (46): Prominent nails.

2) **Malunion:**

a) **Angulation:**

After removal of the nails, radiographic angulation (one patient had varus angulation average 10° , one patients had valgus angulation ranging from 10° to 20° , one patient had average 10° anterior angulation and one patient had 10° posterior angulation). All of these angulations were partially corrected by remodelling after 6 months and were considered accepted according to the criteria mentioned before.^(30,31,32) None of these patients had any evidence of clinical deformation (Figure 47).



anterior
angulation

10°

valgus
angulation

20°

Figure (47): Radiographic angulation

b) Limb-length inequality:

In group I, no Limb-length inequality was present.

In group II, there was Six patients had lengthening 2 cm or less, while one patient had shortening less than 1.5 cm. None of these patients had functional limitations secondary to the limb-length inequality (Figure 48).

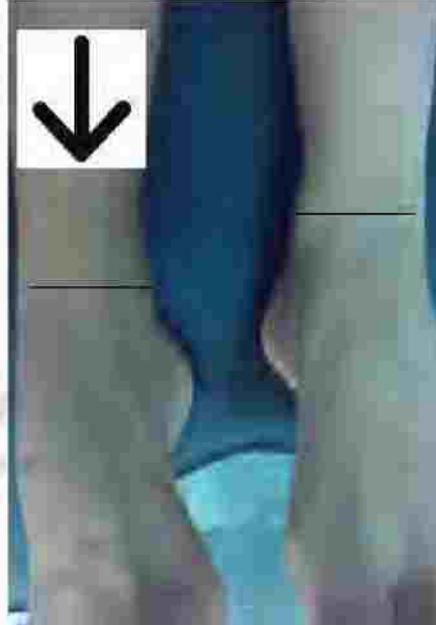


Figure (48): Limb-length inequality.

c) Rotatory deformities:

In group I, no rotatory deformities.

In group II, there was external rotation deformity of 15° or less was encountered in two patients. None of these patients had functional limitations secondary to the rotation deformity (Figure 49).



Figure (49): External rotation deformity (10°).

d) Infection:

In group I, there was three cases of deep infection was encountered needing removal of plate and culture and sensitivity test was done, one case had external fixator but the other two cases treated by intravenous antibiotics and debridement, but in group II, only superficial infection controlled by medical treatment (Figure 50).



Figure (50 a): Deep infection and skin sinus.



Figure (50 b): Superficial infection and skin sinus.

3) Range of knee motion:

In group I, all patients had full range of knee at the end of follow up period except the patient who had infected non union and treated by external fixator (ilizarof).

In group II, there was, one patient had a 10° extensor lag with a range of motion from 10° to 120° after retrieval of the nails. Five patients had a range of motion from 0° to 120°. The six patients regained full active extension and flexion of the knee one to two months later.

CASE PRESENTATION

Group I

Patient (1)

An 8 year-old girl, admitted to El Hadara University Hospital after a road traffic accident on July 2013. She had a shattered spleen, for which splenectomy was done (in the Main University Hospital) and a comminuted fracture of the upper third of the left femur. Surgery was performed 9 days after trauma, closed reduction and fixation using two retrograde flexible intramedullary titanium nails.

Post-operatively, the girl was encouraged to gradually start active exercises in bed. After two weeks, the stitches were removed and partial weight bearing with support was allowed. At six weeks follow up, X-rays showed development of a bridging callus, and full weight bearing was allowed. At 12 weeks follow up, X-rays showed solid fracture healing, and the patient was admitted for removal of the nails. Follow up continued for six months and the outcome was excellent. Figure (51)



Pre-operative AP and lateral views.



Post-operative AP and lateral views.



AP and lateral views after six weeks.



AP and lateral views at end of follow up.



Range of motion at the end of follow up.

Figure (51): Patient (1).

Patient (2)

A nine year-old boy, admitted to El Hadara University Hospital after a road traffic accident on September 2013. He had a transverse fracture of the middle third of the left femur. Surgery was performed eight days after trauma, closed reduction and fixation using two flexible intramedullary titanium nails.

Post-operatively, he was encouraged to gradually start active exercises in bed. After two weeks, the stitches were removed and partial weight bearing with support was allowed. At six weeks follow up, X-rays showed development of a bridging callus, and full weight bearing was allowed. At 12 weeks follow up, X-rays showed solid fracture healing, and he was admitted for removal of the nails. Follow up continued for six months and the outcome was excellent. Figure (52)



Pre-operative AP and lateral views.



Post-operative AP and lateral views.



AP and lateral views after 12 weeks.



AP and lateral views at end of follow up.



Range of motion at the end of follow up.

Figure (52): Patient (2)

Group II

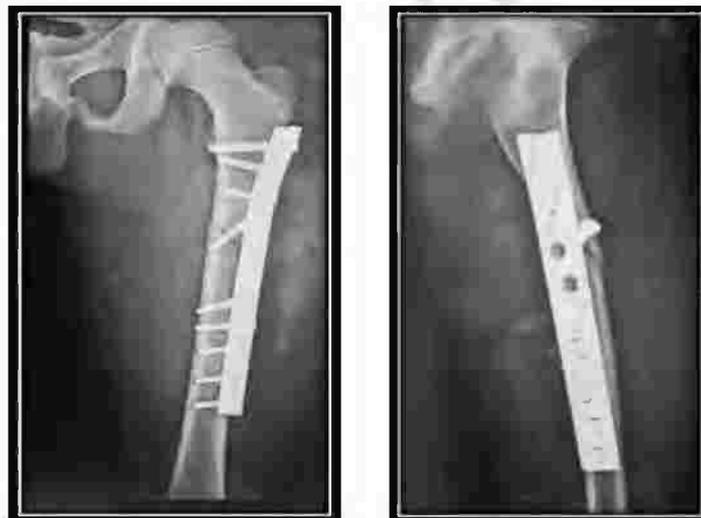
Patient (1)

An eight year-old girl, admitted to El Hadara University Hospital 5 days after a road traffic accident on August 2013. She had an oblique fracture of the upper third of her left femur. A fixed skin traction for 5 days was applied outside the hospital. Surgery was performed 6 days after trauma, open reduction and internal fixation using dynamic compression plate.

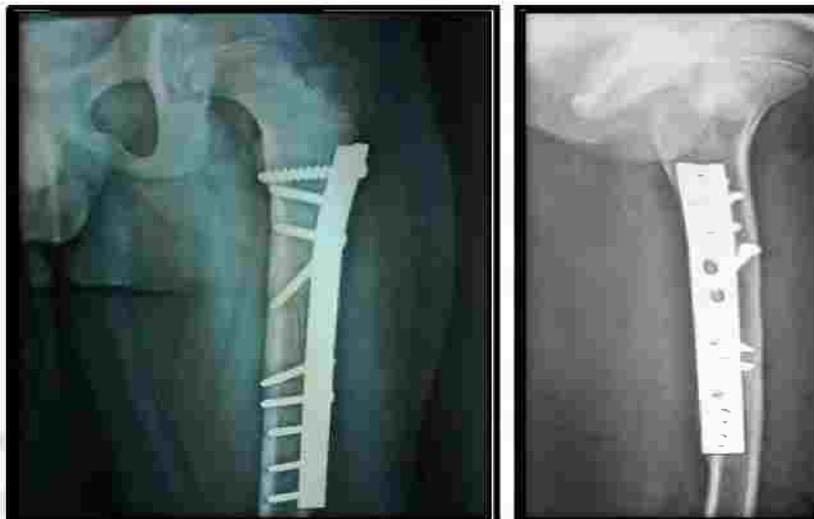
Post-operatively, she was encouraged to gradually start active exercises in bed. After two weeks, the stitches were removed and partial weight bearing with support was allowed. At six weeks follow up, X-rays showed development of a bridging callus, and full weight bearing was allowed. At 12 weeks follow up, X-rays showed solid fracture healing, and she was admitted for removal of the nails. Follow up continued for six months and the outcome was excellent. Figure (53)



Pre-operative AP and lateral views.



post-operative AP and lateral views.



AP and lateral views after 12 weeks.



AP and lateral views at end of follow up.

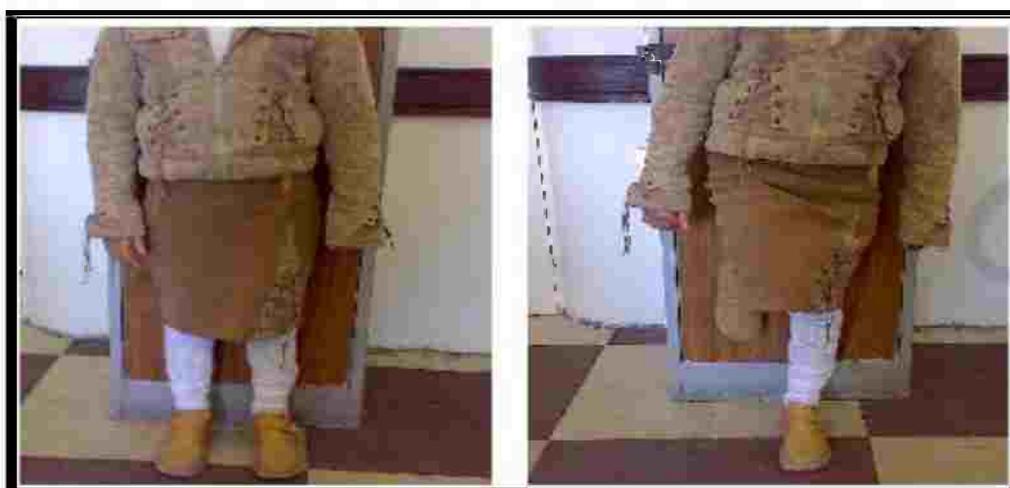


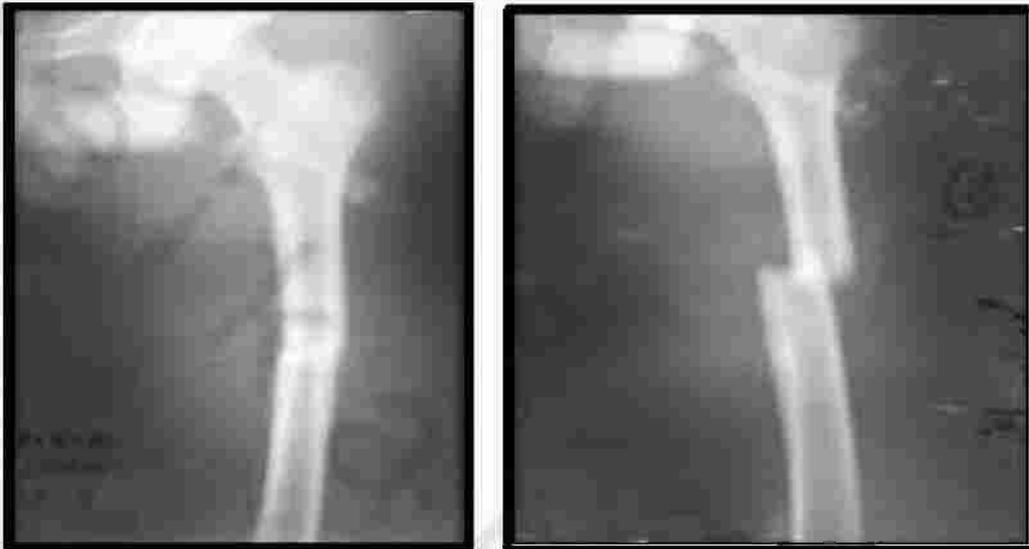
Figure (53): Patient (3).

Results

Patient (2)

A 12 year-old boy, admitted to El Hadara University Hospital after a road traffic accident on November 2013. He had transverse fracture middle of the right femur. Surgery was performed four days after trauma, open reduction and internal fixation using dynamic compression plate.

Post-operatively, the boy was encouraged to gradually start active exercises in bed. After two weeks, the stitches were removed and partial weight bearing with support was allowed. At six weeks follow up, X-rays showed development of a bridging callus, and full weight bearing was allowed. At 12 weeks follow up, X-rays showed solid fracture healing, and he was admitted for removal of the nails. Follow up continued for six months and the outcome was excellent. Figure (54)



Pre-operative AP and lateral views.



Post-operative lateral and AP views.



Lateral and AP views at end of follow up.



Range of motion at the end of follow up.

Figure (54): Patient (4).